☐ Technical Note ☐

Subcutaneous Injection Contrast Media Extravasation: 3D CT Appearance

Dae Cheol Kweon*, Tae Hyung Kim†, Sung Hwan Yang‡,
Beong Gyu Yoo§, Myeong Goo Kim*, Peom Park‖

*Department of Diagnostic Radiology, Seoul National University Hospital,
†Department of Radiology, Asan Medical Center, ‡Department of Prosthetics & Orthotics,
Korean National College of Rehabilitation and Welfare, §Department of Radiotechnology,
Wonkwang Health Science College, ‖Department of Industrial and Information
Systems Engineering, Ajou University

We report a case of an accidental extravasation of contrast material. A large-volume extravasation occurred in an adult during spiral contrast-enhanced CT. The amount of contrast material extravasated was 47 ml. The patient had a swelling of the dorsum right hand. The extravasation injury site was determined by CT scanning. The extavasation case was examined using five separate display techniques: axial, multi planar reformation (MPR), maximum intensity projection (MIP), volume rendering, and shaded-surfaced display (SSD). This paper introduces extravasation with the CT and the three-dimensional appearance.

Key Words: Contrast media, Extravasation, Computed tomography

INTRODUCTION

The administration of contrast material for computed tomography (CT) is typically accomplished either by a hand injection or by a power injector in the gantry room during scanning. The extravasation of intravenously injected contrast medium is a well-recognized complication of radiological examinations. Extravasation is defined as the leakage of the solutions from the vein. The extravasation of water-soluble contrast media can sometimes cause tissue necrosis. Tissue damage from the extravasated contrast material is caused by the direct toxic effect of the agent. Compartment syndrome may also occur if a sufficient amount of contrast material leaks into the surrounding skin and subcutaneous tissues.[1] Skin necrosis after the extravasation of contrast material is a potential complication when mechanical power injectors are use to inject large volume of contrast at a high flow rates.

This report presents a case of compartment syndrome of the dorsum hand immediately following the extravasation of an intravenous injection of contrast material during CT scanning.

The CT studies of the extavasation case site were performed using a 3D software program with five different display techniques: axial (cross sectional), multi planar reformation (MPR), maximum intensity projection (MIP), volume rendering, and shaded-surface display (SSD). This paper presents another subcutaneous Injection extravasation along with the three-dimensional CT findings in a patient who underwent spiral CT enhanced CT scans after November 2003.

MATERIALS AND METHODS

From March to December of 2004, 22 patients were treated for extravasation of contrast medium during computed tomographic scanner investigations. The mean volume injected out of the vein was 53 (10 to 140 ml). There were 16 men and 6 women. The mean age of the patients at the time of injury was 54 (17 to 81) years. Ten extravasations occurred in

Submitted January 26, 2005, accepted March 16, 2005
Corresponding Author: Dae Cheol Kweon, Department of Diagnostic Radiology, Seoul National University Hospital, 28 Yeongeon-dong, Jongno-gu, Seoul 110-744, Korea
Tel: 02)2072-2914, Fax: 02)3672-4948
E-mail: kdc@radiol.snu.ac.kr

out-patients and, 12 occurred in in-patients.

The injuries were sustained in the arm (eight patients), the anterior aspect of the elbow (five patients), the forearm (four patients), and the dorsal aspect of the hand (five patients). There were two patients with compartment syndrome complications. Both patients (140 and 110 ml) complained of pain either during or after administering the contrast medium. Incisions were made all around the area of extravasation. The patients had an emergent fasciotomy.

The intravenous access was acquired by nurses. Technologists began the intravenous injections under physician supervision.

In this report, a 69-year-old patient, a right-handed male, underwent spiral CT venography for a suspected deep vein thrombosis in the lower extremities.

A certified nurse trained in venous cannulations inserted an 18-gauge plastic cannula into the dorsal venous network of the right hand.

Non-ionic iopromide contrast material (Ultravist 370; Schering, Berlin, Germany) was administered at a rate of 3.0 ml/sec, and a pressure of 221 psi using a mechanical injector (Envision CT; Medrad, Indianola, PA).

RESULTS

An extravasation of approximately 47 ml of contrast material in the dorsal venous region of the hand occurred after 16 seconds of the injection. The patient complained of pain during the course of the injection, and the procedure was stopped immediately. The technologist reported visual evidence of an extravasation of contrast material into the hand dorsum and the needle was removed (Fig. 1).

The supervising radiologist was notified. The involved limb was elevated, and cold compresses were applied to the site.[2] The patient was closely monitored. A plastic surgery service was consulted to evaluate the large extravasation.[1]

The extravasation injury area was imaged with a MX8000 four-detector row spiral CT scanner (Philips Medical Systems, Cleveland, OH) with a 21 cm field of view, 1.3 mm slice thickness, 1.3 mm reconstruction interval, 120 kVp, 100 mA, 1.25 pitch, 0.75 second gantry rotation time, and a standard 180 degree interpolator and a reconstruction algorithm.

All axial images were transferred to a workstation installed with PC-based three-dimensional (3D) reconstruction software (Rapidia; Infinitt, Seoul, Korea) (Fig. 2). The volume data were loaded into the 3D program, and an experienced CT technologist performed the 3D reconstruction, which included MPR (Fig. 3), MIP (Fig 4), volume rendering (Fig. 5), and shaded-surface display (Fig. 6). For the axial and MIP images, the display window and level were optimized for this particular contrast density. Volume rendering was optimized for the reconstruction: opacity; 100%, density range; 150-1480. For SSD, a lower display threshold of 192-775 HU, and a 100% opacity were used, which has previously been established as the optimal threshold for this contrast-to-background

Fig. 1. Clinical photograph showing diffuse soft-tissue swelling in the dorsum of the hand, after the extravasation of 47 ml of the contrast material in the subcutaneous tissues.

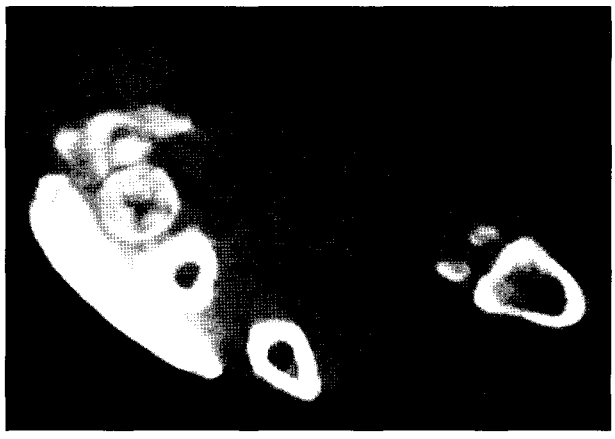

Fig. 2. Axial CT shows large amount of contrast material in the dorsum of the right hand.

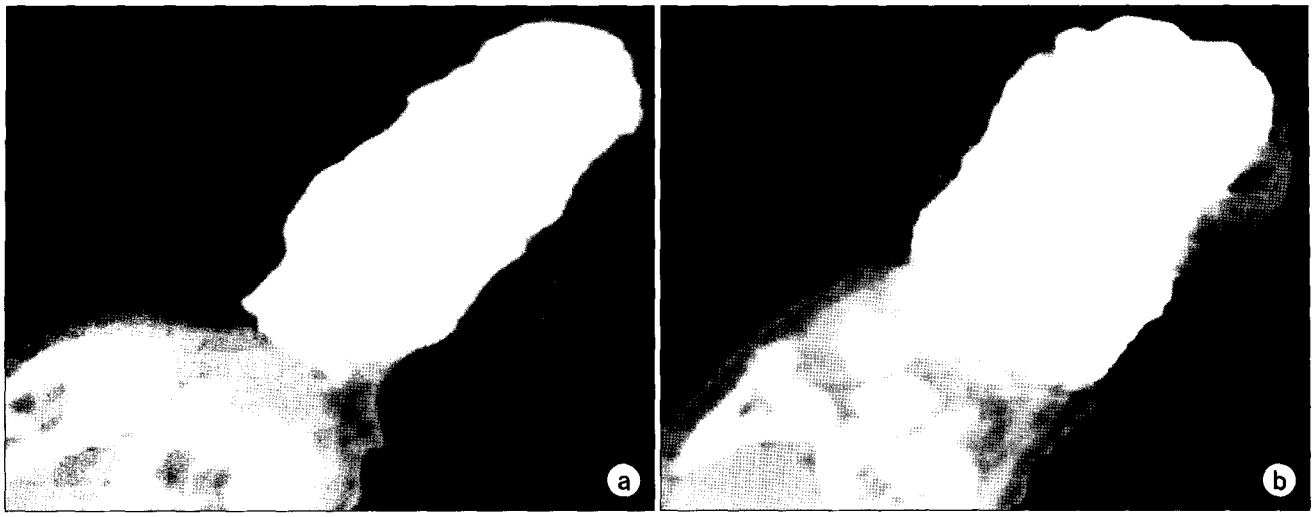

Fig. 3. (a), (b). Coronal MPR images demonstrate the extravasation of contrast material.

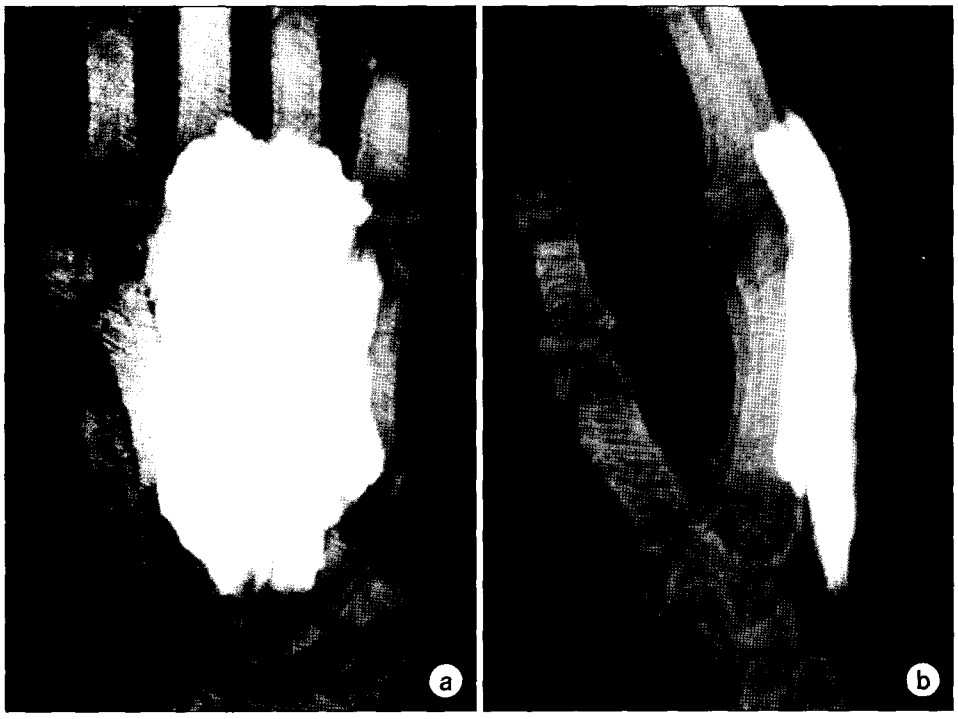

Fig. 4. 3D MIP CT scan images of the dorsum of the right hand. (a) Coronal image demonstrates the extravasation. (b) Lateral image shows extravasation.

density difference.

DISCUSSION

Extravasation injuries are usually caused by leakage around the original puncture site where the catheter enters the vein.

A higher frequency of extravasations have been encountered since routine use of a mechanical power injection of contrast medium for CT was introduced.[3] Traditionally, efforts to avoid extravasation have focused on prevention by exercising special care in high-risk groups.[4]

Subcutaneous extravasation is a well-known complication of a radiological examination involving an intravenous injection of contrast material. Nonionic contrast agents are safer than

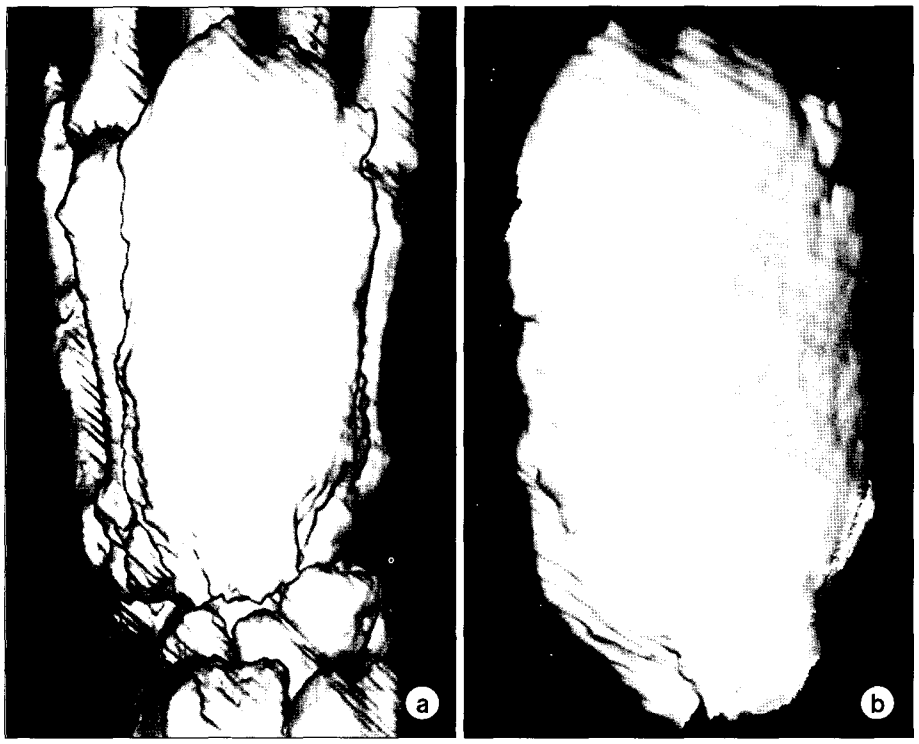

Fig. 5. 3D volume-rendered CT scan images of the hand. (a) Image demonstrates the extravasation. (b) 3D volume-rendered obtained after eliminating the bone, shows the extravasation.

Fig. 6. 3D surface-shaded display of the dorsum hand showing the large area of extravasation.

high-osmolality agents, and in most patients, conservative treatment is successful for the extravasation of small volumes of nonionic agents.[5,6]

The higher risk of extravasation from the venous circulation during contrast-enhanced CT when administered using a power injector with cases of substantial skin necrosis[2] are well documented.[7]

3D visualization techniques are available for acquiring the CT volume data, such as MPR, MIP, volume rendering, and shaded-surface display. Volume rendering is excellent for in depicting 3D images[8] and has advantages over two-dimensional axial views.[9]

There is minimal post-acquisition processing for the volume rendering images was minimal. This technique is easily learned and easily optimized for each case. The software provided on many CT software program allows additional image enhancement with the use color, which might improve the image quality. Five optimized techniques can be used to accurately measure the vessel diameters.[8]

The extravasated contrast material can be observed in the preoperative and/or postoperative films plain radiographs of the affected extremity,[10] and in the body topogram obtained for

abdominal CT.[11] Five separate techniques have been used in the in the performance of CT: axial, multi planar reformation (MPR), maximum intensity projection (MIP), volume rendering, and shaded-surface display (SSD).

Initially, the thin-section axial images were reviewed, in order to identify the extent of the extravasation of contrast material. Thereafter, volume rendering and MPR images were generated to allow a better understanding of the anatomic relationships between the veins and adjacent bones, and soft tissue.

To our knowledge, this study is the first to demonstrate the use of a 3D CT reconstruction in an evaluation of contrast extravasation.

CONCLUSIONS

This study showed that a complete evaluation of the contrast medium extravasation area is possible using all five 3D CT reconstruction settings. In order to prevent serious extravasation accidents, medical personnel need to be aware of the seriousness of the problem. This paper reports the 3D findings in a case of contrast medium extravasation of the dorsum hand. These 3D findings might help to determine the best course of treatment for patient with contrast extravasation.

REFERENCES

1. Cohan RH, Ellis JH, Garner WL: Extravasation of radiographic contrast material: recognition, prevention, and treatment. Radiology 200:593-604 (1996)
2. Spigos DG, Thane TT, Capek V: Skin necrosis following extravasation during peripheral phlebography. Radiology 123: 605-606 (1977)
3. Federle MP, Chang PJ, Confer S, Ozgun B: Frequency and effects of extravasation of ionic and nonionic CT contrast media during rapid bolus injection. Radiology 206: 637-640 (1998)
4. Birnbaum BA, Nelson RC, Chezmar JL, Glick SN: Extravasation detection accessory: clinical evaluation in 500 patients. Radiology 212:431-438 (1999)
5. Sistrom CL, Gay SB, Peffley L: Extravasation of iopamidol and iohexol during contrast-enhanced CT: report 28 cases. Radiology 180:707-710 (1991)
6. Cohan RH, Dunnick NR, Leder RA, Baker ME: Extravasation of nonionic radiologic contrast media: efficacy of conservative treatment. Radiology 176:65-67 (1990)
7. Miles SG, Rasmussen JF, Litweller T, Osik A: Safe use of an intravenous power injectors for CT: experience and protocol. Radiology 176:69-70 (1990)
8. Addis KA, Hopper KD, Iyriboz TA, et al: CT angiography: in vitro comparison of five reconstruction methods. AJR 177:1171-1176 (2001)
9. Li AE, Fishman EK: Evaluation of complications after sternotomy using single- and multidetector CT with three-dimensional volume rendering. AJR 181:1065-1070 (2003)
10. Loth TS, Jones DEC: Extravasations of radiographic contrast material in the upper extremity. J Hand Surg 13:395- 398 (1988)
11. Stein DA, Lee S, Raskin KB: Compartment syndrome of the hand caused by computed tomography contrast infiltration. Orthopedics 16:333-334 (2003)

전산화단층검사에서 조영제의 피하 정맥 혈관외유출 환자의 3D영상

*서울대학교병원 진단방사선과, †서울아산병원 방사선과, ‡한국재활복지대학 의료보장구과,
§원광보건대학 방사선과, ‖아주대학교 산업정보시스템공학과

권대철* · 김태형† · 양성환† · 유병규§ · 김명구* · 박 범‖

전산화단층검사에서 조영제를 자동주입기를 이용해 주입하여 검사하는 경우에 혈관 외 유출된 성인환자를 대상으로 하였다. 환자의 혈관외유출 사고의 조영제 양은 47 ml로 오른쪽 손목 부위가 부종을 동반하였다. 혈관외유출된 손상부위를 axial 스캔하여 MPR (multi-planar reformation), MIP (maximum intensity projection), volume rendering, SSD (shaded-surface display) 기법으로 구성하였다. 이러한 3D 영상은 조영제의 혈관외유출 환자의 예방 및 사후 조치에 적절한 치료계획의 방법으로 기대된다.

중심단어: 혈관외유출, 조영제, CT